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An Error Resilient Technique for Temporal and Spatial Scalable Video

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Introduction

The task targeted here is concerned with source signal processing to allow for the efficient allocation of resources to transmit signals over a clinical network, characterized by highly time varying bandwidth and sudden changes in allocated bandwidths to low priority signals (such as e.g. video).Scalable coding corresponds to an approach to allow for quick variation of fidelity and bandwidth occupancy in the transmission of complex signals over a healthcare network.

In video transmission systems, compressed video is delivered over channels that are not necessarily error free. Channel errors can lead to a mismatch in the encoder/decoder prediction loop which will propagate the errors to the succeeding frames. As a result, the quality of the received video at the decoder side may drop significantly. In this work:

- We aim to reduce the introduced mismatch by modifying the reference.
- Our technique makes use of previously Intra coded blocks and a new leaky prediction structure in order to improve the robustness.
- We extend reference frame modification methods to temporal and spatial scalability in scalable extension of H.264/AVC (SVC).

Scalable Video Coding (SVC)

SVC addresses the heterogeneity of clients by producing a single stream with different layers that fulfill the requirements of different users. The scalable extension of H.264/AVC was finalized in 2007 and achieves better performance comparing to previous video coding standards.

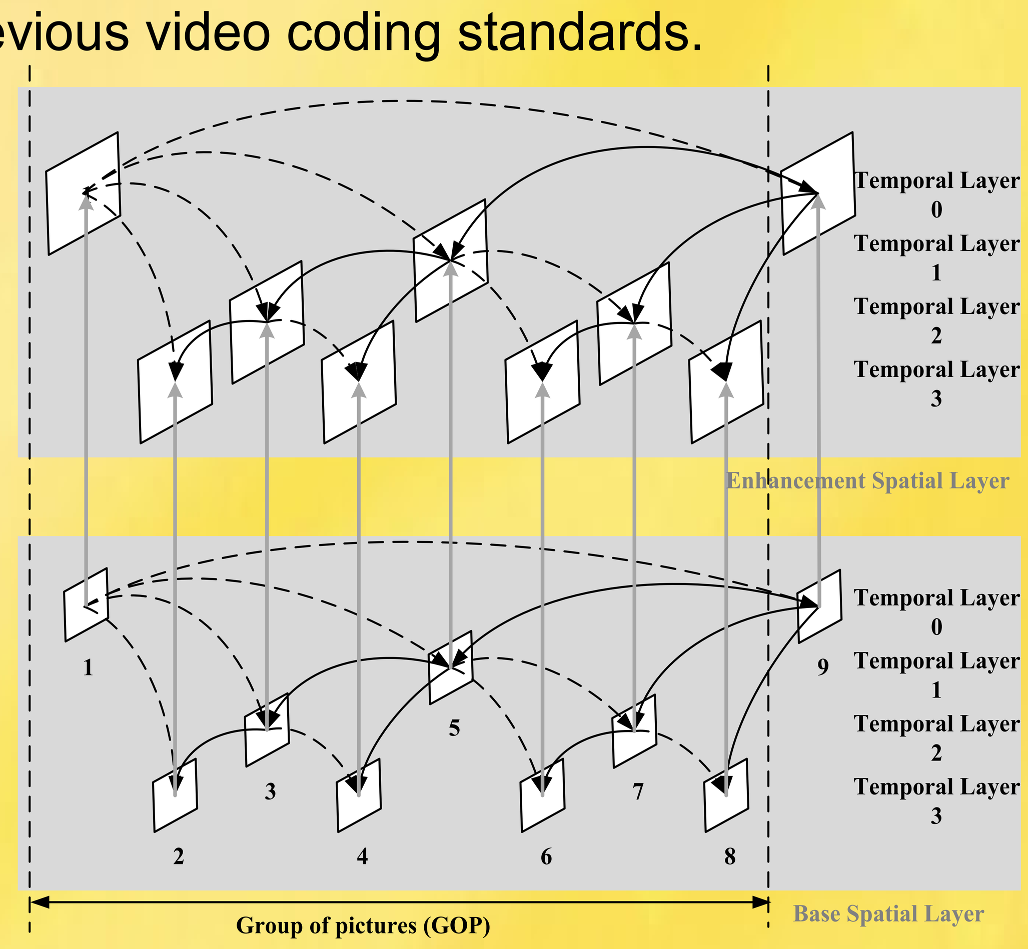


Fig.1. Temporal and spatial scalable structure.

Reference Frame Modification

These methods change the reconstructed frame into a modified one which is less vulnerable to transmission error.

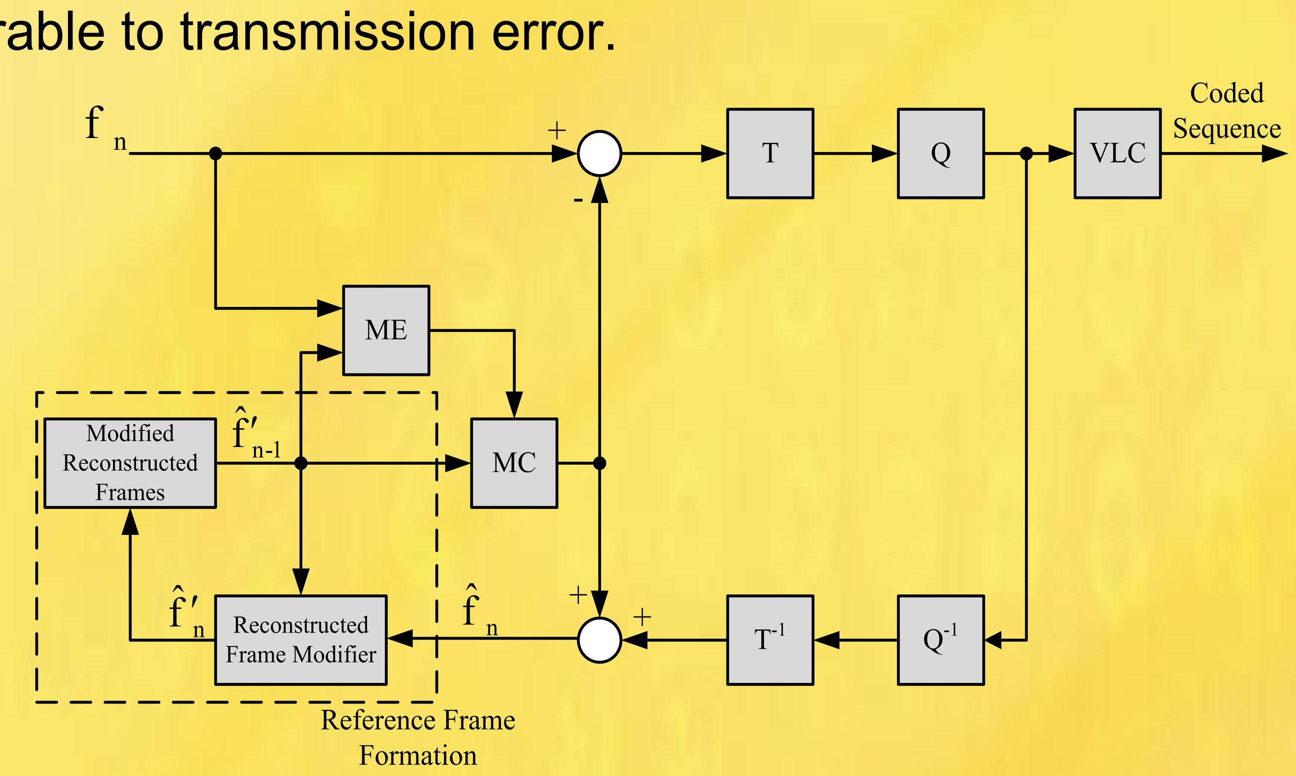
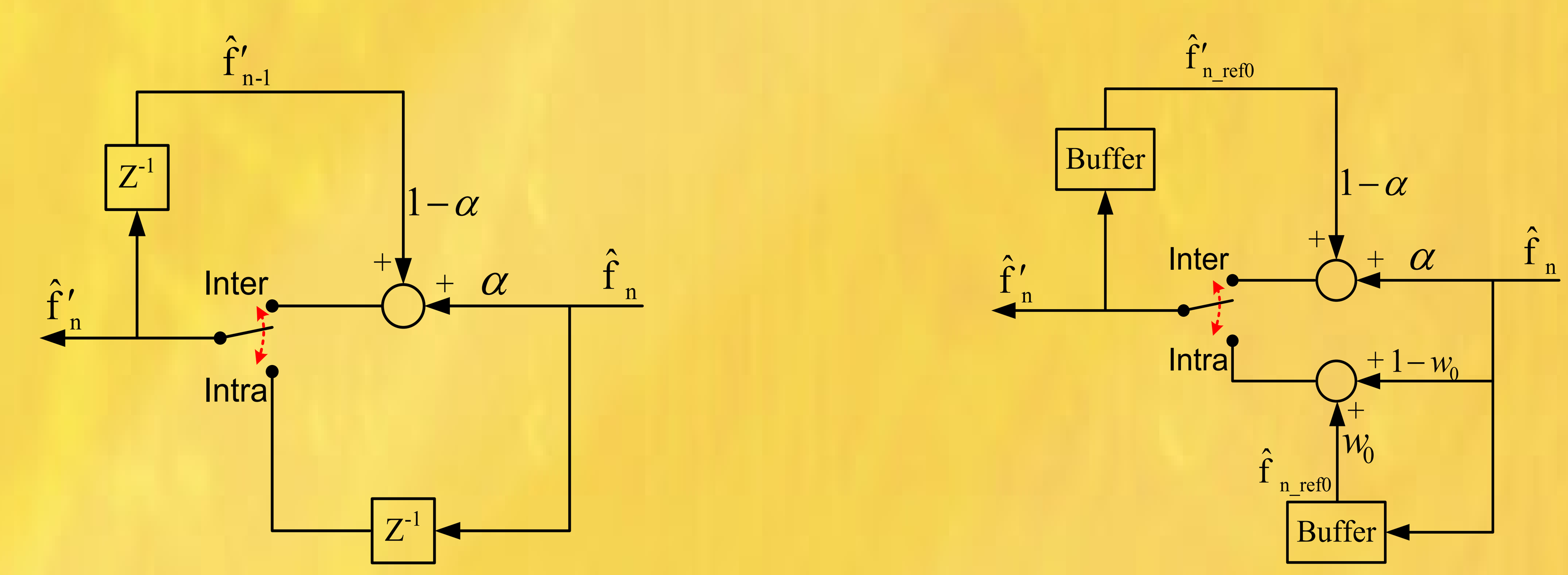


Fig.2. Block diagram of typical hybrid video coding with reference frame modification

a) Leaky b) GSCP



c) IGSCP d) BIGSCP

Fig.3. Different instantiations of the "Reference Frame Modifier" block.

Proposed Method

Leaky prediction will result in exponential decay of error propagation in previous frames but decreases the coding efficiency especially in slow sequences. The constant (K) is usually set to 128 which is the mid range of pixel values (0-255). However, it was observed that 128 is not the best choice for all sequences. In each sequence, based on the content of the video, the range of pixel values varies. In order to improve this technique further, we allow the value of K to vary on a per-MB basis, and we calculate it based on the neighbouring MBs. The constant is set to the average of reconstructed pixel values of neighbouring MBs.

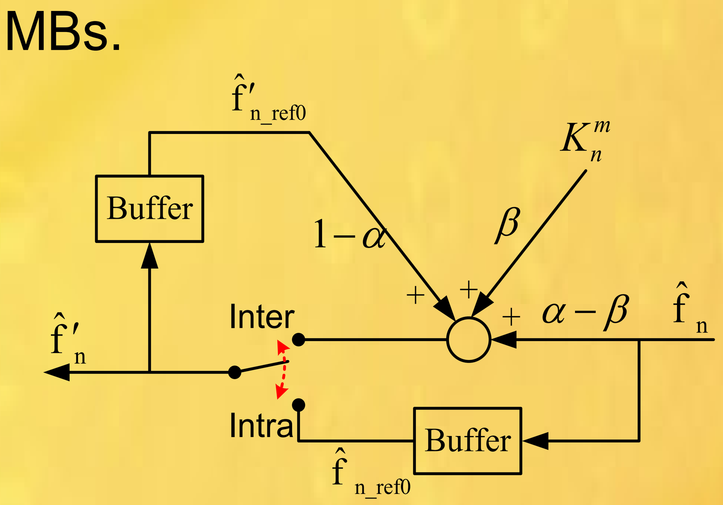
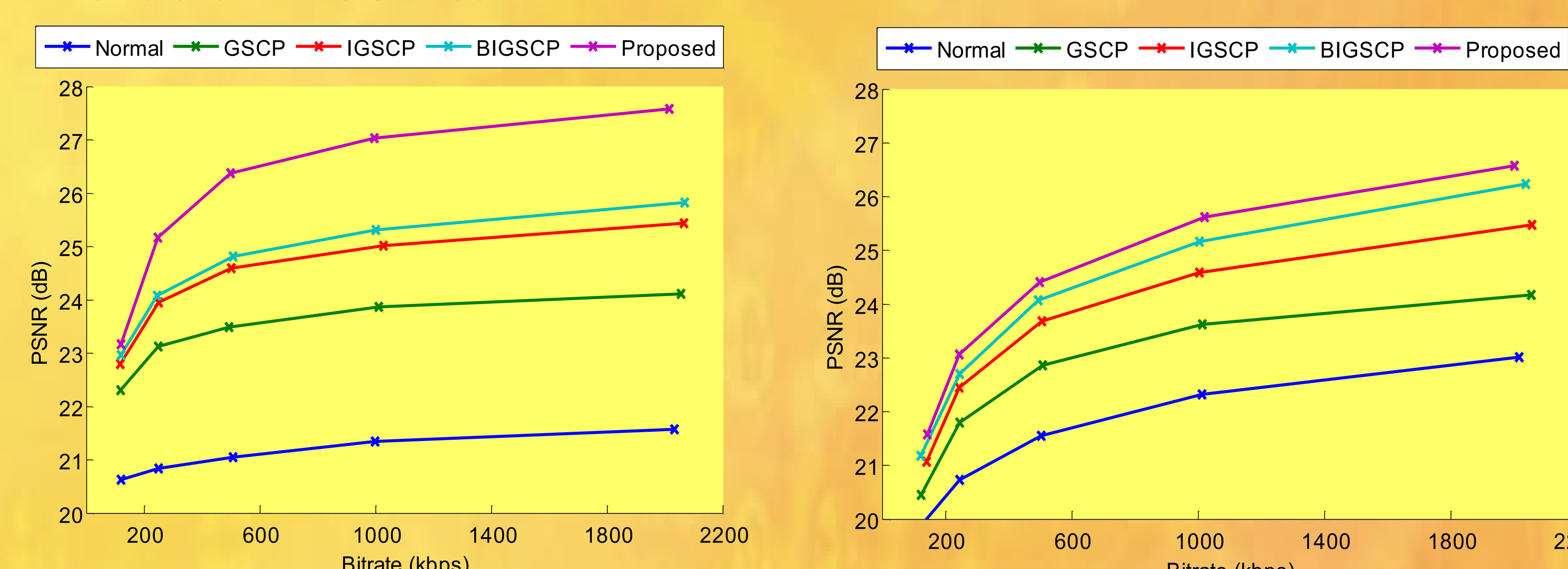


Fig.4. "Reference Frame Modifier" block of the proposed method.

In order to put more emphasis on Intra MBs, both temporal reference frames are used upon availability. In spatial enhancement layer, the Intra MBs in the lower spatial layer are upsampled and used. The proposed method uses:

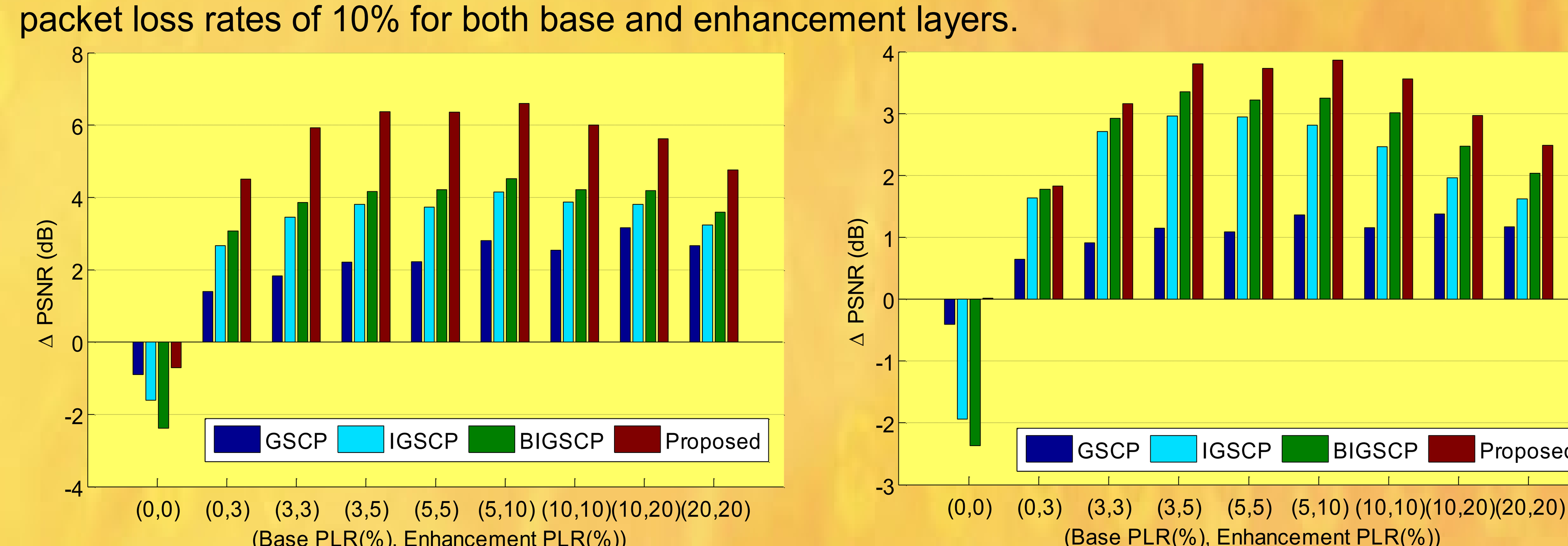
- Error robustness of previous Intra MBs.
- Good prediction resulting from using the previous reference frame.
- Exponential decay of error propagation caused by leaky prediction

Simulation Results:



a) Foreman b) Football

Fig.5. Rate distortion curves for different methods for (a) Foreman and (b) Football sequences with packet loss rates of 10% for both base and enhancement layers.



a) Foreman b) Football

Fig.6. Δ PSNR of different RFM methods over normal coding at various packet loss rates for (a) Foreman sequence and (b) Football sequence at 2000 kbps.